Watersheds of the Ontario Greenbelt

POLICY OPTIONS TO PRESERVE, PROTECT, AND RESTORE THE WATERSHEDS OF THE GREENBELT

David Suzuki Foundation

SOLUTIONS ARE IN OUR NATURE

WATERSHEDS OF THE ONTARIO GREENBELT

Policy options to preserve, protect, and restore the watersheds of the Greenbelt

May 2012

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ABBREVIATIONS

CELA	Canadian Environmental Law Association
GDP	Gross Domestic Product
GGH	Greater Golden Horseshoe
GTA	Greater Toronto Area
MEA	Millennium Ecosystem Assessment
n.d.	No date
NEP	Niagara Escarpment Plan
NHS	Natural Heritage System
OECD	Organization for Economic Co-operation and Development
ORMF	Oak Ridges Moraine Foundation
ORMCP	Oak Ridges Moraine Conservation Plan
PGA	Places to Grow Act
TEEB	The Economics of Ecosystems and Biodiversity

TABLES AND FIGURES

Executive Summary

WATERSHED ECOSYSTEMS FORM PART OF THE NATURAL INFRASTRUCTURE needed for water security, where *water security* refers to both the extractive uses of water (such as drinking water, agriculture and industry) and to the regulation of water-based hazards (such as risks related to pollution, floods and droughts). The increasing recognition of the role of these ecosystems in contributing to water security has led many to emphasize the importance of determining the value of these services (e.g., Smith, de Groot, & Bergkamp, 2006). The resulting valuation studies reinforce the need to invest in maintaining watershed ecosystems, just as we invest in maintaining other types of infrastructure.

In fall 2008, the David Suzuki Foundation released *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services* (Wilson, 2008). That report quantified the value of *non-market* ecosystem services (in other words, services that are considered "free") provided by the Greenbelt's natural capital at $2.6 billion a year. The value of watershed services was over $1 billion a year — approximately 40 per cent of the total value of Greenbelt services.

This report, *Watersheds of the Ontario Greenbelt: Policy Options for Preservation, Protection and Restoration*, focuses on four key watershed services that residents of Ontario depend on at a local level: water filtration, waste treatment, flow regulation and flood and erosion control. The report examines these natural ecosystem services — services that contribute to water security and don't appear on any balance sheet, yet are absolutely necessary for healthy communities. It also reviews outstanding threats and provides policy recommendations for the preservation, protection and restoration of such services.

The policy recommendations result from examining the dominant threats to watershed services, including land use change resulting from urban development, invisibility in commercial markets and skewed public perceptions. The recommendations are grouped into five areas:

- Infrastructure planning that integrates conservation needs
- Agriculture that is water-friendly
- Water budgets that incorporate the ecological needs of watersheds
- Development that is mitigated by growing the Greenbelt
- Healthy ecosystem services that are reflected in pricing structures

Achieving ecological sustainability requires that we recognize and address the interdependence of people and the environments of which they are a part. The watersheds of the Greater Golden Horseshoe provide a range of vital services to the residents of the region, but to maintain these services, we must monitor and adjust our impact on the resources providing them.

The watersheds of the Greater Golden Horseshoe provide a range of vital services to the residents of the region, but to maintain these services, we must monitor and adjust our impact on the resources providing them.

Photo Alex Kotlov

Introduction

WATER IS A CRITICAL COMPONENT OF LIFE and a necessary foundation for the social and economic well-being of societies. Lakes, rivers, wetlands and underground aquifers supply water for drinking, irrigation, recreation and industrial processes. As cities continue to grow, and increasingly draw on these services, a leading policy challenge that affects us all is managing the demands placed on our watersheds.

Worldwide more people now live in urban environments than in rural. This migration from towns, villages and farms to cities has brought about massive land use changes that are degrading the water sources we rely on. Pollution, resource extraction and the loss and fragmentation of sensitive natural areas affect the distribution, quantity and quality of water resources. The growing recognition that functionally intact and biologically diverse watersheds are required for the continued provision of water-based services is leading many to conclude that it is profoundly important to manage the whole system, including both human activities and the physical watershed.

The Greater Golden Horseshoe (GGH) of Ontario is one such region that is grappling with the challenges associated with maintaining healthy, intact watersheds in the face of growing urbanization. Centred on the Greater Toronto Area (GTA) at the western reaches of Lake Ontario, and stretching south to Lake Erie and north to Georgian Bay, the GGH is one of the most densely populated regions of North America. At the time of the 2006 Census, the population was recorded at 8.4 million people — approximately 69 per cent of Ontario's population and close to one-quarter of Canada's total population. The Growth Plan for the Greater Golden Horseshoe (Ontario Ministry of Public Infrastructure Renewal, 2006) projects the region will grow to over 11.5 million people by 2031. This rate of growth is comparable to adding a town the size of St. Catharines to the region every year for the next 20 years.

To cope with the anticipated growth over the coming decades, the Ontario government drafted legislation, policies and plans to provide the tools necessary for sustainable community development while protecting natural features and functions. Of particular significance is the Ontario Greenbelt, a cornerstone of the province's GGH growth plan.

The Greenbelt was created to permanently protect the prime farmlands and environmentally sensitive lands of southern Ontario. It is the world's largest greenbelt at over 1.8 million acres, wrapping around the GGH and encompassing the Oak Ridges Moraine, the Niagara Escarpment, Rouge Park, agricultural land and many rural towns and villages. In many ways the Greenbelt is also a bluebelt. It intersects four major watersheds and protects the range of habitats contained within them, from the headwaters and riparian forests, to the streams and groundwater reserves. This protection is providing essential services for quality of life in this densely populated region of Canada.

This report examines the natural ecosystem services provided by the watersheds of the Greenbelt – services that contribute to water security and don't appear on any balance sheet, yet are absolutely necessary for healthy communities. It also reviews outstanding threats and provides policy recommendations for the preservation, protection and restoration of such services.

PART 1

Ecosystem Services of a Watershed

What Are Ecosystem Services?

Ecosystems, or the community of plants and animals that interact with one another and their physical environment, provide humanity with services that are wide-ranging and diverse, from providing food and regulating waste, to supporting cultural and recreational activities. The collective benefits provided by the resources and processes supplied by natural environments are known as ecosystem services. More specifically, ecosystem services are the transformation of natural resources into things we value. For example, when fungi, worms and bacteria transform sunlight, carbon and nitrogen into fertile soil capable of growing crops, this transformation amounts to an ecosystem service. Although we don't know the full extent of the benefits ecosystems provide, we do know that many ecosystem services are essential for human well-being.

The term *natural capital* implies an extension of the economic notion of capital (that is, a factor of production) to include goods and services related to nature. In this sense, functioning ecosystems act as a form of capital that supplies humans with a stream of valuable goods and services. In fact, *all* economic production requires a flow of natural resources generated by a stock of natural capital. Every activity in our towns and cities depends, either directly or indirectly, on the Earth's ecosystems – and imposes stress on them. The energy for transportation, raw materials for consumer goods, convenient waste disposal mechanisms and the food in our homes and restaurants all depend on biological resources, yet the role of natural resources in production is often economically invisible (The Economics of Ecosystems and Biodiversity [TEEB], 2011). Not surprisingly, some economists have described nature's services as a huge infrastructure for the economy and are warning that we are failing to maintain it (Daly & Farley, 2004). Indeed, the important roles of ecosystem services are not being recognized in economic markets, government policies or land management. Consequently, we are missing some of the signals of decline.

Worldwide, ecosystems are being altered and destroyed at an unprecedented rate. The ground-breaking Millennium Ecosystem Assessment (MEA) (2005) concluded that 60 per cent of ecosystem services are now classified as degraded. These services are taken for granted, partly because of a lack of knowledge regarding

Ecosystems, or the community of plants and animals that interact with one another and their physical environment, provide humanity with services that are wide-ranging and diverse, from providing food and regulating waste, to supporting cultural and recreational activities. PHOTO BY KELLY COLGAN AZAR VIA FLICKR

what they are and what they're worth. The structure of our cities and economies is increasingly separating us from the physical and economic connections that exist between nature and our well-being. For instance, few people are aware of the infrastructure that brings them pure tap water or carries their wastes away, and fewer still understand the ecological trade-offs that are made to allow these conveniences (Baron et al., 2003). And although we attach value to trees when they're harvested for lumber, we fail to attach a value to them when they're left intact to provide services such as clean air. Yet, when we harvest trees from a forest, we are not merely altering the capacity of the forest to generate more trees, we are also altering the capacity of the forest to create ecosystem services, many of which are vital to our survival (Daly & Farley, 2004). Table 1 provides an overview of the ecosystem services of watersheds. Ask yourself how many you are familiar with and how they affect your life. Note the correlation between those ecosystem services not valued in markets and their degradation.

Key Services of a Watershed

Watershed ecosystems form part of the natural infrastructure needed for water security: the extractive uses of water, such as drinking water, agriculture and industry, and to the regulation of water-based hazards, such as risks related to pollution, floods and droughts.

A watershed (or a drainage basin) is a geographic region where all the water and snow that fall within it flows to a common point, such as a river, lake, wetland or pond. The size of a watershed can vary, ranging from the area surrounding a small stream or pond, to an ocean basin that can span multiple provinces and national boundaries. As such, a watershed is more than water. It can include the forests, wetlands, homes, farms and cities that reside within its catchment area. Because watersheds encompass terrestrial, freshwater and coastal ecosystems, watersheds can be directly or indirectly linked to the majority of ecosystem services. For the purposes of this report, watersheds are defined at the scale of lakes, whereas the services of watersheds are restricted to the ecosystem processes that capture, filter and deliver water.

Watershed ecosystems form part of the natural infrastructure needed for water security, where water security refers both to the extractive uses of water (such as drinking water, agriculture and industry) and to the regulation of water-based hazards (such as risks related to pollution, floods and droughts). The increasing recognition of the role of these ecosystems in contributing to water security has led many to emphasize the importance of determining the value of these services (e.g., Smith et al., 2006). The resulting valuation studies are reinforcing the need to invest in maintaining watershed ecosystems, just as we invest in maintaining other types of infrastructure.

In fall 2008, the David Suzuki Foundation released *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services* (Wilson, 2008). That report quantified the value of *non-market* ecosystem services (in other words, those services that are considered "free") provided by the Greenbelt's natural capital at $2.6 billion a year. The value of watershed services was over $1 billion a year — approximately 40 per cent of the total value of Greenbelt services.

This report, *Watersheds of the Ontario Greenbelt: Policy Options for Preservation, Protection and Restoration*, focuses on four key watershed services that residents of Ontario depend on at a local level: water filtration, waste treatment, flow regulation and flood and erosion control.

WATER FILTRATION

Forest and wetland cover in a watershed are integral to a clean water supply. Watersheds control the quality of water entering streams, rivers and lakes, a service of vital importance that would otherwise be performed by costly constructed filtration plants. Pollutants such as viruses, oil, metals, excess nutrients and sediment are absorbed or filtered out of the water by soil and small organisms as it flows through forests and wetlands. Forests can reduce nitrogen in water runoff by up to 90 per cent, whereas wetlands can trap up to 60 per cent of metals and 90 per cent of sediment (Ecological Society of America, n.d.).

TABLE 1: ECOSYSTEM SERVICES OF WATERSHEDS

Ecosystem Service	Benefit	Degraded?	Valued in Market?
Provision of water	Worldwide, greater than 99 per cent of industrial, irrigation and residential water supplies come from natural freshwater systems.	Yes: unsustainable use for drinking, industry and irrigation	Yes, but undervalued because of water subsidies
Water purification	Wetlands filter and break down pollutants, enhancing water quality.	Yes: declining water quality	No
Flow regulation	Forested watersheds regulate the timing and magnitude of water runoff and water flows.	Unknown: varies depending on the ecosystem change and location	No
Flood control	Functionally intact freshwater systems buffer stormwater flows, reducing flood damage.	Yes: loss of natural buffers (wetlands, mangroves)	No
Nutrient cycling	Freshwater systems store and transport nutrients within the watershed.	Unknown	No
Provision of food	Fish, shellfish and waterfowl are important food sources for people and wildlife.	Yes: declining production because of overharvesting	Yes, but undervalued for role in maintaining biodiversity
Timber and other forest products	Timber, mushrooms, berries and other forest products are found in forested watersheds.	Unknown: forest loss in some regions, growth in others	Yes, but undervalued: timber is valued, but many other forest products are not valued
Recreation and tourism	Freshwater ecosystems are sites for swimming, fishing, hunting, boating, wildlife viewing and so on.	Unknown: more areas accessible but many degraded	Yes, but undervalued as many recreational pursuits are free
Habitat for biodiversity preservation	Rivers, streams, floodplains and wetlands provide habitat and breeding sites for numerous aquatic, avian and terrestrial species.	Yes: loss of natural habitats	No
Climate stabilization	The capture and long-term storage of carbon is part of the global carbon cycle.	Yes: preponderance of negative impacts	No
Esthetic, cultural, religious and inspirational values	Natural freshwater systems are sources of inspiration and deep cultural and spiritual values.	Yes: declining quantity and quality of natural lands, rapid decline in sacred groves and species	No
Waste regulation	Healthy freshwater systems are able to absorb and neutralize pollution.	Yes: declining water quality	No

Source: Adapted from Brandes & Ferguson, 2004, and MEA, 2005

In addition, protected watersheds clean water at a lower cost than filtration plants. Watershed protection reduces capital, operation and maintenance costs. A study of 27 U.S. water suppliers compared the treatment costs of drinking water for watersheds with varying levels of forest cover (Ernst, 2004). The results demonstrated that watersheds with a minimum of 60 per cent forest cover incurred half the water treatment cost compared with watersheds with 30 per cent forest cover. They incurred one-third of the cost when compared with watersheds with 10 per cent forest cover. A more recent U.S. study prepared by the Trust for Public Land found a 20 per cent increase in filtration costs for every 10 per cent of forest or wetland cover lost (Ernst, Gullick, & Nixon, 2007). Given that almost half (six of the top 15) of the fastest-growing metropolitan areas in Canada are located in the GGH,[1] this statistic is significant in any consideration of how and where to accommodate and service burgeoning populations (Bonoguore, 2009).

The findings in the above U.S. studies were used to calculate the value of water filtration services in the Greenbelt. If the average forest and wetland cover declined from 30 per cent to 10 per cent, the cost of water treatment for the City of Toronto was estimated to increase from $0.60 per cubic metre to $0.94 per cubic metre (Wilson, 2008). If the increase in filtration costs were passed on to the consumer, the average person living in Toronto would see an annual water bill increase of $381. Using this approach, the annual value of water filtration services in the Greenbelt was then estimated at $131 million.[2]

Wetlands excel at waste treatment. Physical, biological and chemical functions all work together to remove pollutants from water. Riparian wetlands near towns or farmland can treat wastewater or agricultural runoff before it even enters streams or lakes.

WASTE PROCESSING

Societies must expend considerable time, money and energy on the unappealing, yet important task of waste processing in order to protect and advance human health. The buildup of waste in the environment can affect human health (through ailments such as diarrhea, hepatitis and mercury poisoning), local economies (through a reduction in provisioning services) and ecosystem functioning (with dead zones representing extreme interruption). This ecosystem service will continue to grow in importance as human population increases and the practice of placing waste out of reach (for example, dumping at sea or shipping to other jurisdictions) has ceased to be a long-term solution (MEA, 2005). More jurisdictions are turning to wetlands, natural and artificial, for the treatment of waste, which reduces the need for costly waste-treatment facilities.

Wetlands excel at waste treatment. Physical, biological and chemical functions all work together to remove pollutants from water. Riparian wetlands near towns or farmland can treat wastewater or agricultural runoff before it even enters streams or lakes. Every year, one hectare of wetland can absorb thousands of kilograms of nitrogen and phosphorus depending on the type, plants and soil present, whereas riparian wetlands can absorb pollution in the millions of kilograms. The waste-processing capacity of the riparian wetlands of the Greenbelt have been conservatively estimated to remove 22.7 million kilograms of nitrogen and 5.2 million kilograms of phosphorus each year (Wilson, 2008).

All ecosystems, however, can be overwhelmed by waste loading. If populations (and their accompanying production and consumption levels) grow faster than ecosystems can assimilate waste, human health and well-being are at risk, requiring the construction of additional treatment plants. If the municipalities of the Greenbelt were forced to rely on artificial means of waste processing, this reliance would come at an added annual cost of $295 million. This amount represents the costs incurred by waste treatment plants to remove quantities of nitrogen and phosphorus typically treated by intact wetlands, but it does not include the cost of building and maintaining such plants, which could annually amount to millions more.

1 These metropolitan areas include Barrie, Brantford, Guelph, Kitchener, Oshawa and Toronto.

2 Of this $131 million, $86.5 million is attributable to forests and $44.6 million to wetlands.

WATER RUNOFF CONTROL

The infrastructure of cities has led to a growing stock of impervious surfaces, resulting in the alteration of water flows. Water from storms or melting snow that does not soak into the ground collects pollutants as it passes over paved areas, rooftops and bare soil, affecting the water quality of freshwater ecosystems. In addition, land use changes that compact soils and reduce infiltration can cause deficiencies in groundwater recharge and in base flow during dry periods. In urban regions, about 60 per cent of rainwater is discharged into storm drains and local waterways. Compare this rate to vegetated areas where only five to 15 per cent of rainwater runs off the ground (Bolund & Hunhammar, 1999).

Forest and wetland cover are essential for water runoff control. Wetlands store excess water, accumulating it during wet periods and providing a reserve for dry periods by maintaining base flows in adjacent rivers and recharging aquifers. Forests reduce runoff by catching water with their leaves and releasing it through evapotranspiration.[3] Tree roots and fallen leaves promote soil conditions that support water infiltration and slow the rate at which runoff enters waterways, helping to replenish groundwater supply and maintain stream flow (Center for Watershed Protection & US Forest Service, 2008). When wetlands and forests are lost, we must turn to artificial means of controlling water runoff.

Forest and wetland cover are essential for water runoff control. Wetlands store excess water, accumulating it during wet periods and providing a reserve for dry periods by maintaining base flows in adjacent rivers and recharging aquifers

Construction costs for artificial water runoff control are well known to municipalities, as are the many difficulties associated with such systems, such as sewage overflows and infrastructure deficits. For instance, following a business-as usual scenario, a provincial progress report projected a required $33 billion investment in water and wastewater treatment infrastructure to accommodate new population growth in the GGH[4] (Winfield, 2005).

In areas where runoff control services have largely been lost, green infrastructure (that is, natural vegetation and vegetative technologies to provide society with ecological services) is gaining recognition (Green Infrastructure Ontario Coalition, 2011). Alternative strategies include green roofs, permeable pavement, bioretention and infiltration, tree planting and water harvesting. For instance, a study in Tampa found that, in single-family residential zones, a 15.3 per cent increase in canopy coverage can decrease runoff by 17.6 per cent and reduce peak flows by 26.5 per cent (Campbell & Landry, 1999). *Ontario's Wealth, Canada's Future* calculated that forests save us $223 million a year in avoided infrastructure. Further, the report cautioned that a 10 per cent loss in forest cover would require replacement technology costing $27 million to control water runoff (Wilson, 2008).

FLOOD CONTROL

Floods can be devastating. Physical damages to buildings, sewer systems and roads are compounded by injury to people and livestock, which potentially leads to epidemics and diseases. Floods also affect freshwater supplies when infrastructure is damaged and/or water supplies become contaminated. Environment Canada reports 11 major floods in Ontario over the past 15 years. The total cost for just seven of these floods exceeded $65 million (Environment Canada, 2011a). It is no surprise then that flood control was the highest-valued watershed service in *Ontario's Wealth, Canada's Future*, with an estimated annual worth of $379 million.

Flood control is provided almost exclusively by wetlands and delivers benefits on a local scale. Wetlands absorb excess water from rivers or rainfall and store it until peak flows or heavy rains have passed. This process prevents excess water from flowing into nearby towns or cities and eliminates the need for engineered flood

3 Evapotranspiration is the sum of evaporation and transpiration from the land to the atmosphere. It accounts for the movement of water within a plant and the subsequent loss as vapour into the atmosphere.

4 Costs are for the area bounded by Midland in the north to Fort Erie in the south, and by Waterloo in the west to Peterborough in the east.

controls such as dams, diversions or dikes. A wetland can typically absorb over 14,000 cubic metres of water per hectare (United States Environmental Protection Agency, 2006). This amount is over 12 times the annual amount of water consumed by the average Toronto household (City of Toronto, 2011) and enough to flood 39 average-sized homes thigh-deep (American Rivers, 2011). The capacity of the environment to absorb water is inhibited by deforestation and urban development, which overwhelm drainage systems and increase peak flows.

Although putting a value on nature's ecosystem services is a complicated subject, this snapshot of four key services should demonstrate that healthy, intact ecosystems undeniably provide services to society that are of economic value.

SUMMARY

The values of four key watershed services provided by forests and wetlands in the Greenbelt are listed in Table 2. The annual value of these services is approximately $1.1 billion. Wetlands represent just 12 per cent of the area, yet they collectively account for more than 40 per cent of the ecological values and are the highest-valued land cover class, both in this assessment, which examines a subset of watershed services, and in the overall assessment, which considers a wider range of services across a greater number of landscapes. Of the services provided by wetlands, flood control was identified as the most valuable service of wetlands, followed by waste treatment. Forests, on the other hand, have tremendous value for water runoff control services and water filtration.

Although putting a value on nature's ecosystem services is a complicated subject, this snapshot of four key services should demonstrate that healthy, intact ecosystems undeniably provide services to society that are of economic value. By making nature's value visible, decision-makers at all levels can take into account the true benefits and costs of conserving and restoring nature in our communities. The preservation of natural capital in the Greenbelt is a low-risk strategy that local governments can employ to minimize the costs of having to replace nature's services through expensive infrastructure.

TABLE 2: WATERSHED SERVICES OF THE GREENBELT

Ecosystem Service	Value of Forests/Year	Value of Wetlands/Year	Total Watershed Service Value/Year
		$millions	
Flood control		$379.7	$379.7
Water runoff control	$278.1		$278.1
Waste treatment	$10.6	$283.6	$294.2
Water filtration	$86.5	$44.6	$131.1
Total annual value ($ million)	**$375.2**	**$707.9**	**$1,083.1**
Total value/hectare	$2,054.83	$7,529.73	

Source: Adapted from Wilson, 2008

What Builds Up and What Breaks Down Watershed Services?

Watersheds are highly interconnected. Their many components interact with one another and are affected by bordering ecosystems as well as by human activities within their domain. Our actions in watersheds can strengthen and reinforce their ability to supply numerous life-supporting ecosystem services — actions such as restoration, protection and regulations or policies that strive to ensure human activities are kept within the limits of ecosystem capacity. But our actions can also break down watersheds. Between healthy ecosystems and ecosystem services, there are a number of steps and linkages. Decision-makers need to understand these steps and linkages to maintain an acceptable level of ecosystem services for their constituents.

THE UNDERLYING MECHANISMS OF HEALTHY WATERSHEDS

Watersheds differ greatly from one another depending on their location, climate and type. Nonetheless, they share important features and drivers of health. Five interconnected environmental drivers regulate the structure, function and processes of watersheds, including the flow regime, sediment and organic matter inputs, temperature and light characteristics, chemical and nutrient conditions and the biotic assemblage (Baron et al., 2003; Brandes & Ferguson, 2004). A narrow focus on any single environmental driver will fail to protect the structure and function of the watershed. Each driver is explained more fully below (Brandes & Ferguson, 2004):

- FLOW REGIME is determined by the rates and pathways by which rainfall and snowmelt enter, exit and circulate within a watershed. This environmental driver encompasses water movement among river channels, lakes, wetlands and connecting groundwater.
- SEDIMENT AND ORGANIC MATTER INPUTS combine to create physical habitat structure, refugia (that is, an area where organisms can survive through a time of unfavourable conditions), spawning grounds and substrate. In addition, these inputs provide and store nutrients for aquatic plants and animals.
- TEMPERATURE AND LIGHT CHARACTERISTICS regulate the productivity, metabolic processes and the physical activity of aquatic plants and animals.
- CHEMICAL AND NUTRIENT CONDITIONS regulate pH, water quality and the productivity of aquatic organisms.
- BIOTIC ASSEMBLAGE (that is, the diversity of plant and animal species) affects ecosystem process rates and community structure.

When watersheds lack adequate water, in terms of quantity, quality or rate of flow, negative ecological consequences follow. Many people only realize that watershed services are degraded when the social uses of water are affected (Baron et al., 2003). The net benefits we receive from these services are reduced by our failure to preserve and maintain ecosystems. We can artificially replace some of these services, but certainly not all.

Watersheds are highly interconnected. Their many components interact with one another and are affected by bordering ecosystems as well as by human activities within their domain.

PART 2

The Changing Landscape of the Region

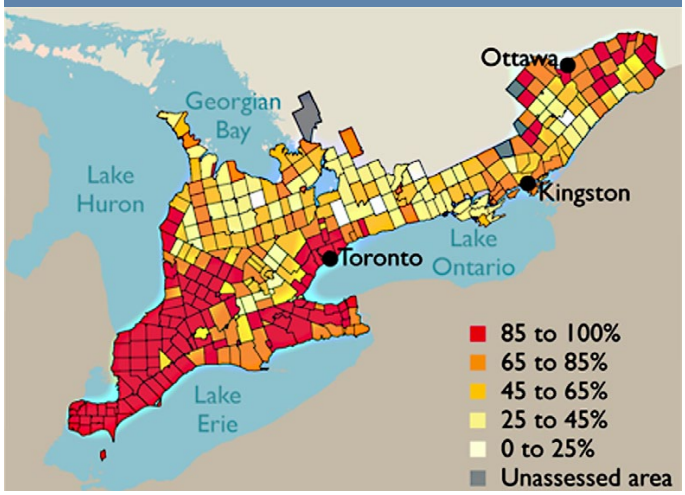
The wetlands and forests of the GGH have been hit hardest by the increase in human activities in the region.

THE LANDSCAPES OF THE GGH UNDERWENT CONSIDERABLE TRANSFORMATION in the past century, compelling the creation of the Greenbelt in 2005. A recent analysis of all land conversion in the Greenbelt from 1993 to 2007 showed that 68 per cent of land conversion was for the buildup of urban areas, 15 per cent for golf courses, 13 per cent for pits and quarries and four per cent for miscellaneous purposes (Cheng & Lee, 2008).

The wetlands and forests of the GGH have been hit hardest by the increase in human activities in the region. Approximately 85 per cent of Ontario's wetlands have been lost since settlement (see Figure 1), drained for agriculture, urban development, encroachment, land clearance and filling (Ducks Unlimited Canada, 2010). Metro Toronto (particularly Etobicoke, North York, Scarborough and York) has suffered massive losses of wetlands (on average 96.7 per cent), whereas smaller losses have occurred in the central southern counties of Durham, Peterborough and Northumberland (38.2 per cent, 37.9 per cent and 43 per cent, respectively). Despite the recognized importance of wetlands, drainage and destruction continues. The protection and restoration of existing wetlands is required to maintain flow regimes, chemical and nutrient composition and biotic assemblages.

Across southern Ontario, woodland losses have exceeded the losses of almost any other major ecosystem. Currently, less than 0.1 per cent of the land base is in vital old growth forest (Ontario Nature, 2006). Continued loss will almost certainly influence the delivery of the ecosystem services because of changes in sediment and organic matter inputs, temperature and light characteristics and biotic assemblage. To mitigate this impact, intact old growth forests must be protected, along with the smaller sites of early successional forests and plantations that serve as corridors for diverse species (Rusak, n.d.).

FIGURE 1: WETLAND LOSS IN SOUTHERN ONTARIO (CA.1800–2002)

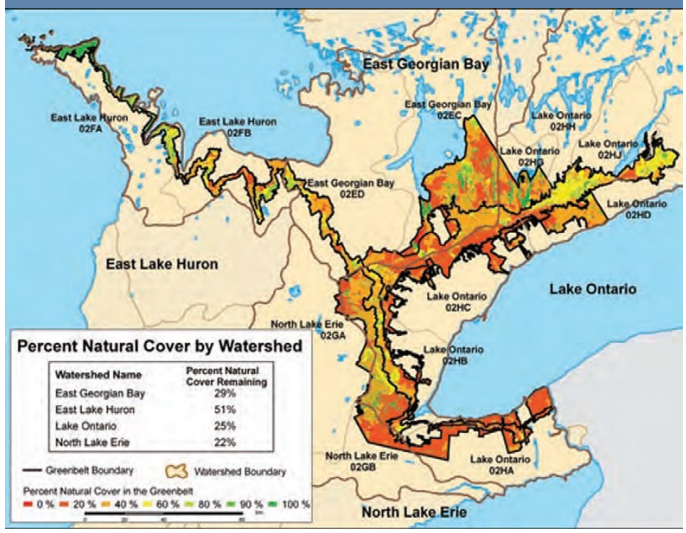


Source: Ducks Unlimited Canada, 2010

Watersheds of the Greenbelt

Turning our attention to the specific watersheds of the Greenbelt, four large watersheds — East Lake Huron, East Georgian Bay, North Lake Erie and Lake Ontario — provide millions of people with clean drinking water and recreational opportunities, as well as support a vast range of business opportunities (see Figure 2). The quality of this valuable resource depends on the health of the entire watershed including the forests, wetlands, streams and rivers. The four watersheds are reviewed here and summarized in Table 3.

FIGURE 2: WATERSHEDS OF THE GREENBELT



Source: Wilson, 2008

EAST LAKE HURON

Almost half of all sub-watersheds in the Greenbelt flow into Lake Huron. The East Lake Huron watershed extends from Tobermory in the west to Collingwood in the east and as far south as Durham, and it supports the smallest human population of the sub-watersheds: fewer than 50,000 inhabitants. The section of the watershed within the Greenbelt has approximately 51 per cent forest and wetland cover, with over 80 per cent of its natural cover intact (Wilson, 2008). The region contains some of the most valuable natural capital in southern Ontario and contains multiple nature reserves. The wetlands along the coast of Lake Huron and Georgian Bay are classified as Good or Very Good (Federal, Provincial, & Territorial Governments of Canada, 2010). In *Ontario's Wealth, Canada's Future,* the services of the East Lake Huron watershed are shown to have the highest total value of all four watersheds, estimated at $4,000 to $5,000 per hectare (Wilson, 2008).

EAST GEORGIAN BAY

The East Georgian Bay watershed extends southeast from Collingwood to Orangeville and then northeast from Orangeville around the eastern side of Lake Simcoe. This watershed is mostly agricultural land and is home to approximately 300,000 people. The section of the watershed within the Greenbelt has 29 per cent forest and wetland cover and has lost 60 to 80 per cent of its natural cover (Wilson, 2008). The estimated value of ecosystem services in the East Georgian Bay watershed is $3,000 to $4,000 per hectare.

TABLE 3: WATERSHED CHARACTERISTICS OF THE GREENBELT

	East Lake Huron	East Georgian Bay	North Lake Erie	Lake Ontario
Forest and wetland cover[a]	51%	29%	21.7%	24.5%
Intact natural cover[b]	80%	20 to 40%	22%	25%
Population[b]	50,000	300,000	1,000,000	7,000,000
Ecological value/hectare[a]	$4,000 to $5,000	$3,000 to $4,000	$3,000 to $4,000	$2,000 to $3,000

Sources: [a]Federal, Provincial, & Territorial Governments of Canada, 2010; [b]Wilson, 2008

NORTH LAKE ERIE

The North Lake Erie watershed forms a triangle between Dunnville, Dundalk and London, with the north shore of Lake Erie as its southern border. This watershed intersects with a very small portion of the Greenbelt, with only five per cent of the sub-watershed in the Greenbelt flowing into Lake Erie. It is home to almost 1 million people. Within the Greenbelt, it has 21.7 per cent forest and wetland cover and has lost more than 80 per cent of its natural cover (Wilson, 2008). The estimated value of ecosystem services in the North Lake Erie watershed is $3,000 to $4000 per hectare.

LAKE ONTARIO

The Lake Ontario watershed forms a belt around Lake Ontario connecting Buffalo, Brant, Brampton, Richmond Hill and Peterborough. This watershed has some of the most built-up area in all of Canada and supports over 7 million people, about one-fifth of the Canadian population. Only 24.5 per cent of the area within the Greenbelt is natural forest or wetland cover, and over 80 per cent of the wetlands have disappeared along the shores of Lake Ontario (Federal, Provincial, & Territorial Governments of Canada, 2010; Wilson, 2008). The Greenbelt in this watershed has the lowest ecological value of all four watersheds, estimated at $2,000 to $3,000 per hectare. This lower value may seem counterintuitive, as scarcity should signal higher prices. And this expectation would be met, *if* ecosystem services were represented in markets. The values represented here, however, signal the ability of the Lake Ontario watershed to provide non-market ecological services, services that have been eroded along with the erosion of the ecosystem. In fact, the remaining wetlands along the shores of Lake Ontario are now classified as Very Degraded and Highly Degraded (Federal, Provincial, & Territorial Governments of Canada, 2010).

The Lake Ontario watershed forms has some of the most built-up area in all of Canada and supports over 7 million people, about one-fifth of the Canadian population.

Where Do We Stand on Watershed Protection?

The importance of maintaining natural ecosystems for human well-being gained heightened recognition in Ontario following the Walkerton tragedy in 2000[5] and was reinforced with the publication of the MEA (2005) and recent estimates of population growth in the region. Although this short report cannot address the multitude of laws, policies and plans that affect the watersheds of the Greenbelt, it provides a brief review of the latest steps taken to protect watersheds and their associated services.

LEGISLATION RESULTING FROM THE WALKERTON INQUIRY

The Report of the Walkerton Commission of Inquiry (Ontario Ministry of the Attorney General, 2002) resulted in four pieces of legislation: the Safe Drinking Water Act (2002) to address the management of drinking water; the Nutrient Management Act (2002) to address agricultural issues; the Clean Water Act (2006) to address source protection; and the Water Opportunities and Water Conservation Act (2010) to address financing water systems. In combination, this package of legislation supports a multi-barrier approach to water management, which includes protecting water sources from contamination, providing effective treatment, testing frequently and comprehensively, monitoring and reporting, training waterworks operators, ensuring a secure distribution system and responding quickly when problems are found (Canadian Environmental Law Association, 2011b).

The Clean Water Act (2006) is of particular relevance to the ecosystem services featured in this report. The legislation requires source protection committees to develop science-based assessment reports and source protection plans at the local level. These plans consider the occurrence and movement of water through the natural environment, identify existing and potential threats to water and determine the necessary actions to reduce or eliminate significant threats to the relevant watershed. At this time, the municipalities within the Greenbelt are in various stages of developing source protection plans.

Plans consider the occurrence and movement of water through the natural environment, identify existing and potential threats to water and determine the necessary actions to reduce or eliminate significant threats to the relevant watershed.

ECOSYSTEM PROTECTION POLICIES

The Ontario government brought into force the Places to Grow Act (PGA) in 2005, which aimed to ensure growth occurred in a coordinated and strategic fashion, while recognizing the need to protect important natural resources. Under the authority of the PGA, the Ministry of Public Infrastructure and Renewal prepared the Growth Plan for the Greater Golden Horseshoe, which established density targets and planning priorities for managing growth. The Greenbelt Act and Plan (2005) complemented the Growth Plan by protecting the prime farmland and natural capital of the GGH. The PGA is an important piece of legislation to protect ecosystem services against continued urban sprawl. However, its effectiveness largely depends on the specifics of the Greenbelt Plan and its ability to integrate with existing plans and legislation, such as the Oak Ridges Moraine Conservation Plan, the Niagara Escarpment Plan and the Clean Water Act (2006).

The Greenbelt Plan applies to 728,000 hectares of land, including 400,000 hectares designated as Protected Countryside. Over 300,000 hectares of land are already subject to the requirements of the Niagara Escarpment Plan (NEP) and the Oak Ridges Moraine Conservation Plan (ORMCP). The Protected Countryside includes existing settlement areas defined as Protected Countryside and also comprises land that falls under three agriculture-based designations. Layered over top of these designations is the Natural Heritage System (NHS). The NHS covers over half (53 per cent) of the Protected Countryside and provides the policy framework for the protection of key natural heritage and hydrologic features (Environmental Commissioner of Ontario,

5 The Walkerton tragedy refers to events in Walkerton, Ontario, in 2000, when seven people died from drinking E. coli–contaminated water and thousands more became ill.

TABLE 4. LAND USE POLICIES AND DESIGNATIONS IN PROTECTED NATURAL AREAS

Existing or Proposed Land Use	Greenbelt Plan Natural Heritage System	Niagara Escarpment Plan	Oak Ridges Moraine Conservation Plan Natural Core Areas
New mineral aggregate extraction operations	Yes (except in significant wetlands, significant woodlands and significant habitat of endangered species and threatened species)	No	No
Expansion of existing mineral aggregate extraction operations	Yes	Yes (only limited expansion of existing sandstone quarries permitted)	No (not beyond the boundary of the area under licence or permit)
Major recreational uses (for example, ski hills, golf courses, serviced camp grounds)	Yes	No (low-intensity uses permitted)	No (low-intensity uses permitted)
New waste management facilities (for example, landfills, incinerators)	Yes	No	No
Transportation infrastructure (for example, public highways)	Yes	Yes	Yes
Human settlement area expansions	No	No	No
Agricultural uses (existing and new)	Yes	Yes (existing operations permitted, but not new operations)	Yes
Water taking	Yes	Yes	Yes
Forest management (including wood harvesting)	Yes	Yes	Yes

Source: Environmental Commissioner of Ontario, 2005

2005; Ontario Ministry of Municipal Affairs & Housing, 2011). Municipalities are tasked with designating prime agricultural and rural lands, as well as defining the boundaries of key natural heritage features. An examination of the activities permitted in the NHS, however, reveals some areas of concern.

Protected Countryside policies do afford particular attention to water-based resources through the Water Resource System, a complement to the Natural Heritage System. Identified areas of significance include the upper reaches of watersheds, major river valleys and lands around primary discharge zones. The policies stress comprehensive, integrated and long-term planning that embraces a systems approach. All hydrological planning is encouraged to use the watershed scale and to include cross-jurisdictional and cross-watershed considerations. Although these policies are ecologically sound and structured to protect watershed services, they are weakened by related policies, such as the activities permitted in and around watersheds (see Table 4).

A range of infrastructure developments are permitted throughout the Protected Countryside, including transportation corridors and water and wastewater treatment systems. New or expanded mineral aggregate extractions can be established in most of the Protected Countryside,[6] but they are subject to enhanced site rehabilitation requirements. Also, renewable resource activities, such as forestry, water taking and fisheries, are permitted throughout the Protected Countryside.

6 New or expanded mineral aggregate extractions can be restricted within certain natural heritage features.

Remaining Threats to the Watersheds of the Greenbelt

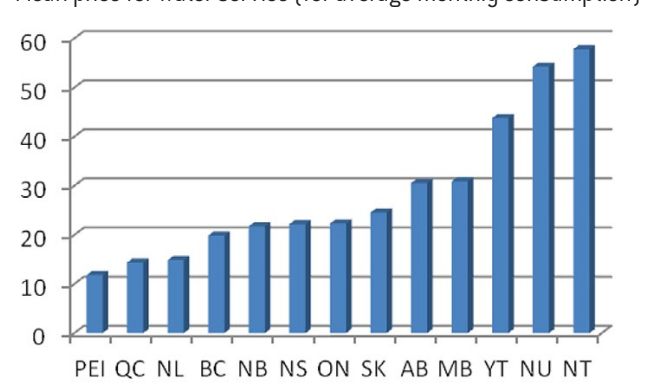
The laws, policies and plans described here are a welcome measure of relief for the watersheds of the Greenbelt. The Ontario government should be commended for its actions. However, a number of threats remain. Dominant threats to watershed services include land use change resulting from urban development, invisibility in commercial markets and skewed public perceptions. Whereas land use change represents a direct threat, the latter threats are indirect. These threats reinforce one another, and as with the environmental drivers of health discussed earlier, a narrow focus on one threat will probably fail to bring about the desired result of improved watershed functioning.

INDIRECT THREATS

Many ecosystem services are absent from the marketplace, and given that economic measures such as GDP guide much decision-making, this situation is potentially very dangerous. Although ecosystem goods (such as food) are tangible and have a clear market signal of value (that is, price), services such as climate stabilization are intangible and often lack market recognition. The absence of built-in market mechanisms means that there is no signal of degradation or loss of services. The situation is particularly acute in Canada where water prices have been artificially deflated because of government grants and incentives for infrastructure development aimed at encouraging public health, urban growth and industrial development (Brandes & Ferguson, 2004). Canadian water is the cheapest in the industrial world, which is on average less than half of the water prices in OECD countries (Organization for Economic Co-operation & Development, 2004). Within Canada, the province of Ontario ranks among the lower-paying provinces for water (see Figure 3).

Ontario is working to reverse this phenomenon, however. After decades of flat rates, the province is increasingly moving toward volume-based pricing, because water consumption is 76 per cent higher under a flat rate than under a metered rate (Environment Canada, 2010a). In fact, 91 per cent of residential consumers and 97.5 per cent of businesses are metered for water use (Environment Canada, 2010a). Ontarians' daily residential water usage per capita is now among the lower rates in Canada. Although this level of usage is certainly moving in the right direction, water pricing requires further modification to account for the full ecological and infrastructure costs of this service.

FIGURE 3: AVERAGE RESIDENTIAL WATER PRICES ($/MONTH) BY PROVINCE



Source: Environment Canada, 2008

The second indirect threat is closely related to and reinforced by the first: the Canadian myth of water abundance. Relatively speaking, Canada is blessed with fresh water. Occupying approximately seven per cent of the Earth's landmass and representing just 0.5 per cent of the global population, Canada is home to nine per cent of renewable water worldwide (Environment Canada, 2003). This myth is particularly entrenched in Ontario, because the province is bordered by the world's largest reservoir of fresh water — the Great Lakes. However, much of this water is unavailable for human use. A significant portion is locked up in glaciers and icefields, or in the northern reaches of the country. In fact, only three per cent of our national freshwater lakes and rivers are located in populated regions (Statistics Canada, 2003). Limited water supply is becoming a reality here at home. Between 1994 and 1999, 25 per cent of Canadian municipalities faced water shortages as a result of increased use, drought or infrastructure limitations (Environment Canada, 2002). Ontario has experienced lower than average precipitation and low water levels since 1998 (Ontario Ministry of Natural Resources, 2003).

DIRECT THREATS

Land use change resulting from urban development affects the flow regime, temperature and chemical and nutrient conditions of a watershed. Urban development, and the resulting conversion of pervious surfaces to impervious surfaces, fragments waterways, raises pollutant loads and increases the urban runoff of toxic substances, nutrients and sediments. It also decreases wildlife habitat (Hascic & Wu, 2006; Langpap, Hascic, & Wu, 2008). Larger variances in water flows and temperatures often result (Tang, Engel, Pijanowski, & Lim, 2005). Although the watersheds of the Greenbelt now enjoy considerable protection, certain land use policies threaten the ability of the Greenbelt to maintain ecosystem services. Aggregate mining, infrastructure expansion and excessive nutrient loading from agricultural practices are the key direct threats to the watersheds of the Greenbelt.

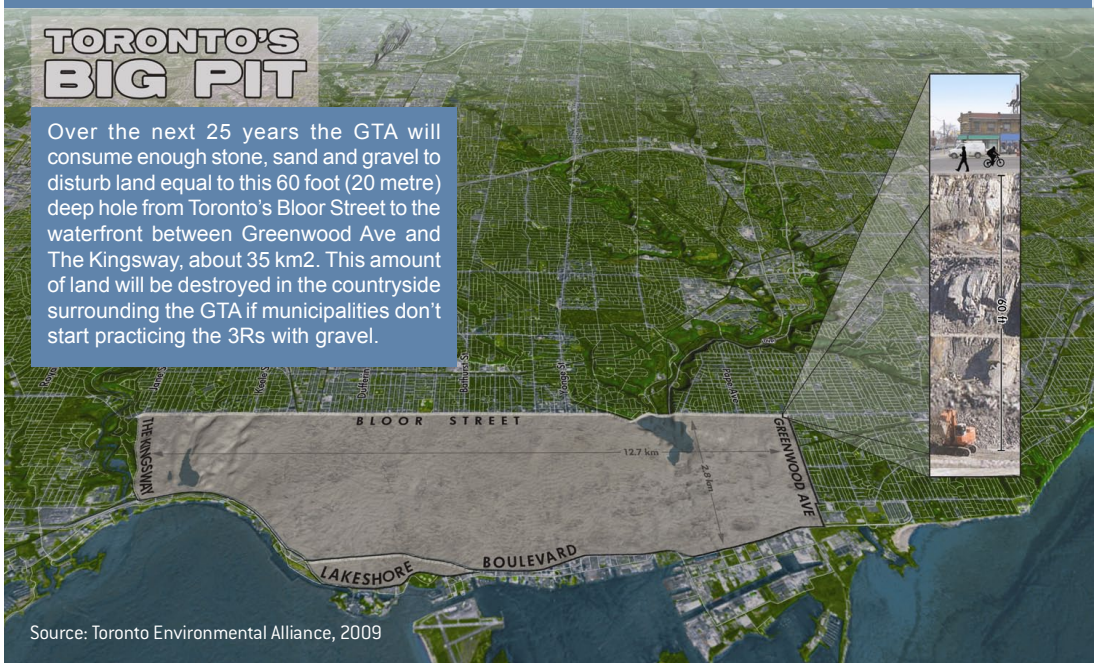
Aggregate mining

Aggregate mining and urban development are intricately linked, as aggregate is used extensively for road and home construction. Aggregate extraction uses open pit mining where topsoil is removed and a large pit is dug that can descend below the water table. Quarries remove high-quality filtration material (affecting water filtration), pump millions of litres of water daily through dewatering (disrupting flow regime) and involve activities such as on-site fuel storage (risking chemical contamination) (Ontario Greenbelt Alliance, 2010). Although aggregate mining may be recognized as being responsible for only 13 per cent of land conversion, it poses significant threats to the Greenbelt. This activity eliminates most ecological services provided by the land cover and can disrupt the water supply for people who depend on groundwater or well water. Furthermore, it is allowed in protected areas and requires maintenance in perpetuity.

Although aggregate mining may be recognized as being responsible for only 13 per cent of land conversion, it poses significant threats to the Greenbelt.

Despite the Greenbelt being a refuge for natural capital, it is blemished by hundreds of active or abandoned pits and quarries. These pits and quarries are classified as "interim uses of the land" (Provincial Policy Statement, 2005, section 2.5.4); however, destroyed ecosystems and source water aquifers are irreplaceable. And although the province requires 100 per cent rehabilitation of pits and quarries, one study found that "less than

FIGURE 4: GTA EXTRACTION DEMAND OVER THE NEXT 25 YEARS



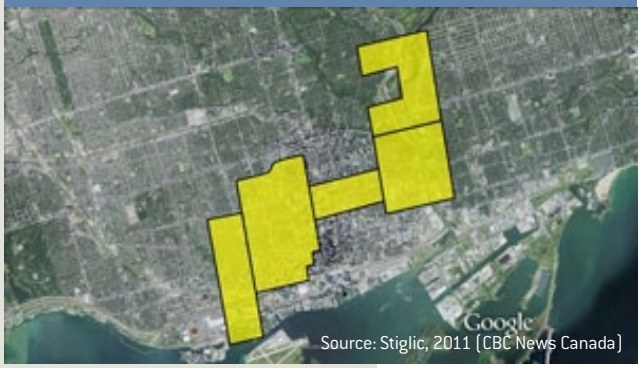
Source: Toronto Environmental Alliance, 2009

CASE STUDY: Melancthon Mega-Quarry

The proposed Melancthon Highland mega-quarry is not located within the Greenbelt, but is less than ten kilometres away and is within the East Lake Huron watershed. The shear size of the project, with its anticipated impacts upon local, interconnected water tables, rivers, and watersheds should sound alarm bells signaling the potential threat to the watershed services of the GGH Greenbelt.

The mega-quarry is 937 hectares (about 2,000 acres), which amounts to 65 per cent of the total natural land conversion to quarry pits and extraction between 1993 and 2007 within the Greenbelt (see Figure 5). The proposed quarry is intended to mine 1 billion tonnes of limestone over 50 to 100 years. Digging will occur in sections that are 300 acres across (about 121 hectares) by 200 feet deep (about 60 metres). Because the proposed quarry is below the water table, the water that seeps into the pits (up to a maximum of 600 million litres a day) must be collected and re-injected or pumped back into the aquifer. Once a section is fully mined, rehabilitation will involve re-laying soil on the quarry floor to help return the land to agricultural use. The proposed quarry site is located at the headwaters of five rivers and will require diverting all the water contributing to the rivers and a larger watershed. This diversion will alter, disrupt and destroy filtration processes, fish and wildlife habitats and groundwater resources for multiple watersheds, including the Nottawasaga, Grand River and Saugeen watershed systems, as well as the Mad, Noisy, Pine and Boyne sub-watersheds. One million Canadians use the groundwater regulated by these watersheds.

FIGURE 5: PROPOSED MELANCTHON QUARRY SUPERIMPOSED ON DOWNTOWN TORONTO



Source: Stiglic, 2011 (CBC News Canada)

Sitting next to the mega-quarry is the existing Walker Aggregates quarry, which opened in 1965. This facility is proposing an expansion of approximately 170 acres, which would destroy 98 acres of interior forest woodland. Together, these open pit mines could potentially expose the area to nearly 150 years of blasting and heavy truck traffic, within 600 metres of each other.

Sources: MAQ Aggregates Inc. Highland Quarry Addendum Planning Report, 2010; McLellan, Yundt, & Dorfman, 1979

half of the land disturbed in aggregate production between 1992 and 2001 has actually been rehabilitated" (Winfield & Taylor, 2005, p. 10). At present, many of Canada's biggest aggregate quarries are on the Niagara Escarpment – a UN World Biosphere Reserve, which is home to over 40 per cent of Ontario's rare species and a major source water area for southern Ontario.

Looking forward, the aggregate industry anticipates that the GTA will use about 1.5 billion tonnes of aggregate over the next 25 years (Toronto Environmental Alliance, 2009). To appreciate the scale of this usage, imagine a hole from Toronto's Bloor Street to the Waterfront, and from Greenwood to the Kingsway, that is 60 feet (about 20 metres) deep (see Figure 4). Within the Greenbelt, it is projected that 35 square kilometres of agricultural and ecologically sensitive land will be destroyed to meet aggregate needs. Proposed quarries include Nelson Aggregates plan for a 200-acre quarry on the sensitive Mount Nemo plateau in Burlington, part of the Niagara Escarpment. The Norval Shale quarry has also been proposed for development in one of the rare remaining natural areas in Brampton (Ontario Greenbelt Alliance, 2010).

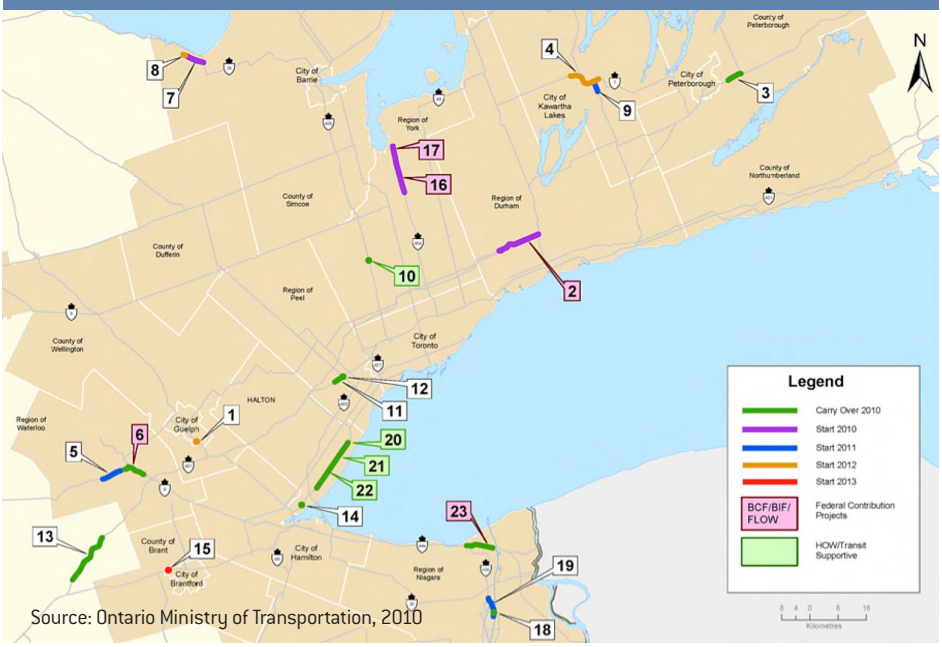
Lastly, Ontario's current fee is 11.5 cents per tonne of aggregate extracted, which fails to reflect social and environmental costs. As a result, there is no incentive to pursue sustainable aggregate extraction or production practices, and recycled material is not a cost-efficient option (Binstock & Carter-Whitney, 2011).

Infrastructure expansion

The expansion of highways increases the area of impervious surface cover and disrupts water flow, decreasing the ability of watersheds to provide key ecosystem services. Between 2000 and 2031, close to $44 billion is projected for investments in transportation infrastructure (Ontario Greenbelt Alliance, 2004). The Southern Highways Program annually approves multiple highway expansion projects, four of which run through the Greenbelt (see Figure 6). Proposed projects include the 404 north expansion (which will place considerable stress on the Maskinonge River), the eastward extension of the 407 (which will dissect prime agricultural lands and a fragile watershed), the Niagara-GTA highway corridor (which may affect the Niagara Escarpment) and the GTA East-West Corridor (which will further encourage sprawl) (Ontario Greenbelt Alliance, 2010).

The construction of a two-lane highway can consume more than 15,000 tonnes of aggregate per kilometre. A six-lane freeway can consume over 48,000 tonnes of aggregates per kilometre of roadway (Environmental Commissioner of Ontario, 2003). Ontario only recycles seven per cent of aggregate and persists in the unnecessary and exploitive use of virgin aggregate, when essentially all aggregate can be recycled, particularly for road repair.

FIGURE 6: HIGHWAY EXPANSION IN THE GOLDEN HORSESHOE (2010–2014)



Source: Ontario Ministry of Transportation, 2010

Increased nutrient loading

Although a key purpose of the Greenbelt is to protect agricultural lands, unsustainable farming methods can negatively affect watershed services. Over the past 30 years, residual soil nitrogen has been increasing in Ontario farmlands, with 52 per cent of farmland in 2001 classified as having very high residual soil nitrogen (that is, over 40 kilograms of nitrogen per hectare) (Agriculture & Agri-Food Canada, 2010). This level does not necessarily pose any harm to agriculture, but it does pose a downstream threat to water quality because rising levels of nitrogen may be too much for the ecological systems to handle. The runoff produced by agriculture increases nutrient loading, which in turn exacerbates dissolved oxygen fluctuations and algae growth (Hascic & Wu, 2006; Langpap et al., 2008). In extreme cases, dead zones can lead to problems with algal blooms and massive fish kills, and they may threaten the drinking water for millions of people.

Highly concentrated agriculture is one of the leading causes of degraded surface waters (Baker, 1992). The GGH region is optimal farming land, containing much of Ontario's class 1, 2 and 3 agricultural lands. Although many of these farms lie outside of the Greenbelt, farms in the vicinity can impact water services if they share a watershed.

PART 3

Policy Recommendations to Conserve Watersheds

THE NEEDS OF WATERSHED ECOSYSTEMS AND THE NEEDS OF SOCIETY for water services must be addressed collectively if freshwater ecological integrity is to be maintained or restored. This final section reviews existing policies that aim to strike this balance. It also includes policy recommendations to protect the underlying mechanisms of watershed services by addressing direct and indirect threats to their health and integrity.

INFRASTRUCTURE PLANNING MUST INTEGRATE CONSERVATION NEEDS

Land use change is the most pervasive threat to watersheds. Highway expansion, aggregate mineral extraction and infrastructure threaten the ecological integrity of the Greenbelt watersheds. The province must provide specific guidance and support to municipalities, thus taking the leading role in making and implementing planning and infrastructure decisions. In addition to policies to address specific impacts, policy options for wetland and watershed restoration are vitally important for the Greenbelt. The following policy recommendations address conservation needs:

- Improve coordination between the transportation, planning and energy ministries to ensure that infrastructure is necessary, does not bisect natural areas and does not extend sprawl patterns.
- Incorporate and encourage the use of green infrastructure, water conservation and low-impact development methods in land use planning and building decision-making.
- Expand the regulatory definition of infrastructure funding to include activities geared to protecting, expanding, monitoring and maintaining green infrastructure.
- Require conservation initiatives as a condition of infrastructure funding in large municipalities.
- Incorporate into any environmental assessments impacts on ecosystem services.

Land use change is the most pervasive threat to watersheds. Highway expansion, aggregate mineral extraction and infrastructure threaten the ecological integrity of the Greenbelt watersheds.

AGRICULTURE MUST BE WATER-FRIENDLY

Farming activities have become a focus in efforts to protect water supply. In the Report of the Walkerton Commission of Inquiry (2002), Justice O'Connor recommended that all large or intensive farms, as well as all small farms located in a sensitive or high-risk area, develop plans to protect drinking water sources that are consistent with the local watershed-based source protection plan (Ontario Trillium Foundation, 2004). In addition to such water protection plans, the following policy recommendations address farming activities:

- Design and pilot different approaches to acknowledge and reward farmers and rural landowners for the provision of ecological goods and services.
- Invest in the environmental cost-sharing programs of the Environmental Farm Plan for implementation of best management practices for agricultural water efficiency by increasing the funding caps and percentage of cost share from 30 per cent to more than 50 per cent for water-conserving practices.

Although source protection is not taking place yet, the provincial government has committed to implementing all 22 recommendations from the Walkerton Inquiry Report that address source protection

WATER BUDGETS MUST INCORPORATE THE ECOLOGICAL NEEDS OF WATERSHEDS

Ontario has begun to build ecological needs into its water-planning framework. By protecting existing and future sources of drinking water and implementing protective measures, water management is taking place in the context of the watershed. Although source protection is not taking place yet, the provincial government has committed to implementing all 22 recommendations from the Walkerton Inquiry Report that address source protection (CELA, 2011a). A necessary first step to developing source water protection is the explicit recognition that rivers and wetlands are legitimate users of water. The following policy recommendations support this concept:

- Set clear, science-based conservation targets that assign accountability and include transparent public reporting.
- Recognize and account for the connections between surface water and groundwater in licensing decisions.
- Incorporate a "sustainability boundary" on water use in licensing decisions to acknowledge the ecological limits of watersheds and to educate users about those limits.

DEVELOPMENT MUST BE MITIGATED BY GROWING THE GREENBELT

Initiatives to expand the borders of the Greenbelt have emerged in numerous cities in the GGH. They strive to further mitigate the threat of encroaching urban development. In 2008, the provincial government formalized a process that identified seven criteria that municipalities employ to identify additional lands to be added to the Greenbelt. Since that time, communities surrounding the Greenbelt have been working to build a stronger connection to local farmland and the natural capital that cleans and treats our air and water. This policy recommendation backs this movement:

- Extend the Greenbelt to include areas threatened by leapfrog development, as well as in areas where expansion efforts have begun (that is, Brampton, Guelph, Halton Hills, Markham, Mississauga, Oakville, Prince Edward County and Toronto).

HEALTHY ECOSYSTEM SERVICES MUST BE REFLECTED IN PRICING STRUCTURES

This final group of recommendations addresses indirect threats to watershed services. Ecosystem services are largely unrecognized in our market economy. Even where they are recognized, they tend to be neglected in policy because they are "free." Incorporating ecosystem services into pricing structures can and should happen at multiple levels. These policy recommendations may help begin this process:

- Incorporate volume-based pricing into water and sewage services that recognizes the value of lost ecosystem services, as well as the costs of building and maintaining replacement infrastructure.
- Implement full cost accounting, as mandated by the Sustainable Water and Sewage Systems Act (2002). The full cost of water and sewage services should include costs associated with source protection, operations, financing and infrastructure replacement and maintenance.
- Incorporate legal liability for environmental damage into development permits within the Greenbelt. The European Union's Directive on Environmental Liability with Regard to the Prevention and Remedying of Environmental Damage, which addresses the quantitative and qualitative impacts on water caused by discharges and withdrawals, can serve as a model (Brandes & Ferguson, 2004).
- Develop and implement property tax differentiation to encourage the stewardship of privately owned land within the Greenbelt. This recommendation will involve determining tax rates based on the conservation of natural capital and encourage the use of green infrastructure, such as green roofs, tree planting, bioretention and infiltration, permeable pavement and water harvesting to improve water health.

Achieving ecological sustainability requires that we recognize and address the interdependence of people and the environments of which they are a part.

Concluding Remarks

Watersheds in the Greenbelt are supported by a number of innovative policies, including the Growth Plan for the Greater Golden Horseshoe, the Niagara Escarpment Plan, the Oak Ridges Moraine Conservation Plan and the Clean Water Act (2006). These progressive policies need to be bolstered, however, as significant threats to the watersheds remain. A combination of the policy recommendations here is ideal. The specific combination will vary depending on the characteristics of the watershed at hand.

Achieving ecological sustainability requires that we recognize and address the interdependence of people and the environments of which they are a part. The watersheds of the Greater Golden Horseshoe provide a range of vital services to the residents of the region, but to maintain these services, we must monitor and adjust our impact on the resources providing them.

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This David Suzuki Foundation report is the fifth in a series that examines natural capital and ecosystem services in Canada's major urban centres. The report assesses the vital ecological services provided by four major watersheds within the Ontario Greenbelt services valued at more than $1 billion per year and provides recommendations about how to maintain and enhance these essential services.

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